Research Problem Review 78-5

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ENGAGEMENT SIMULATION FOR ARMORED CAVALRY: INITIAL TEST

UNIT TRAINING AND EVALUATION SYSTEMS TECHNICAL AREA

U. S. Army
Research Institute for the Behavioral and Social Sciences

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Engagement Simulation

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(6) ENGAGEMENT SIMULATION FOR ARMORED CAVALRY: INITIAL TEST

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UNIT TRAINING AND EVALUATION SYSTEMS TECHNICAL AREA

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FOREWORD

The Unit Training and Evaluation Systems Technical Area of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) has developed a broad research program designed to lead to more effective training of combat units in the Army. The U.S. Army Training and Doctrine Command (TRADOC) has identified small-unit tactical engagement simulation training as one of its highest behavioral science research priorities.

ARI developed the tactical engagement simulation training method known as REALTRAIN, which provides extremely realistic and motivating training for small combat arms units. The method is described in ARI Technical Report S-4 and ARI Research Report 1191. Validation of REALTRAIN for rifle squads is described in ARI Research Report 1192.

This problem review describes the initial stages in developing REALTRAIN for armored cavalry units. A preliminary version was presented to the Military Testing Association at San Antonio, Tex., in October 1977. This research was conducted within the December 1976 Five Year Test Program as approved by the Army Test Schedule and Review Committee. The entire program is responsive to the requirements of Army Projects 2Q763743A773 and 2Q763743A780 and the TRADOC System Manager for Tactical Engagement Simulation (TSM-TES) of the U.S. Army Training Support Center, Fort Eustis, Va. The development of armored cavalry REALTRAIN was conducted as part of Army Project 2Q763743A773.

ARI research in this area is conducted as a joint effort of in-house and active Army personnel augmented by contract support. The work reported here was done jointly by personnel of ARI, TSM-TES, the 3rd Armored Cavalry Regiment at Fort Bliss, Tex., and Human Sciences Research, Inc., McLean, Va., under Contract DAHC 19-76-C-0049.

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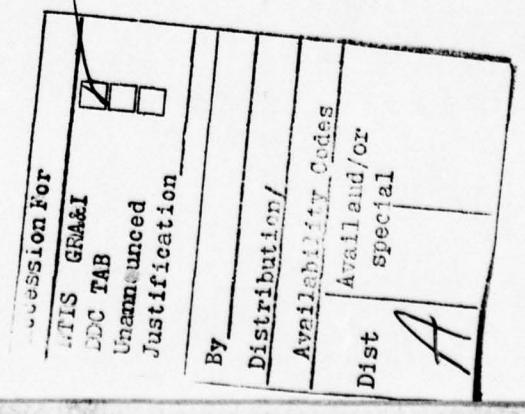

ENGAGEMENT SIMULATION FOR ARMORED CAVALRY: INITIAL TEST

BRIEF

Requirement:

To develop engagement simulation (ES) for armored cavalry; specifically, to examine procedures for emphasizing reconnaissance functions in engagement-simulation exercises and for incorporating reconnaissance functions into the controller debrief and After Action Review. Also, to examine controller procedures and the control system, and the effectiveness of weapons effects and signature simulators for armored cavalry weapons.

Procedure:

In preliminary field tests during basic noncommissioned officer courses (BNCOC) at Fort Hood, Tex. (Jan.-Feb. 1977), and Fort Bliss, Tex. (Apr. 1977), small-scale exploratory tests examined draft procedures and hardware devised to simulate armored cavalry weapons.

Procedures developed in the preliminary field tests were revised and tested in platoon exercises in May 1977, with troop support from the 3rd Armored Cavalry Regiment at Fort Bliss. Controller training was conducted in practical exercises with the platoons divided into sections, so that opposing forces were scouts versus scouts, infantry versus infantry, and so on. In subsequent platoon versus platoon exercises, all armored cavalry weapon systems, including 4.2 inch mortar, were represented on each side. Missions were selected from the "Army Training and Evaluation Program for Armored Cavalry Squadron and Armored Cavalry Troop."

Findings:

Procedures and techniques were devised and refined for (a) training controller personnel; (b) assessing casualties in desert terrain, using optical devices and map coordinate information; (c) encouraging appropriate information-gathering and -reporting behaviors in reconnaissance missions; (d) employing mortar elements; (e) delivering indirect fire simulators by helicopter; (f) simulating effects and signatures of organic weapon systems; (g) collecting training data for use by senior controllers in After Action Reviews; and (h) preparing exercise sketches and narratives for training and research purposes.

In questionnaire responses, participants and controllers indicated that they benefited from the training exercises.

Utilization of Findings:

Results from these initial tests provide a basis for further development and refinement of engagement-simulation procedures and equipment for armored cavalry units, and for recommendations for revising the training program for armored cavalry.

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INTRODUCTION

Infantry and Combined Arms Engagement Simulation

Engagement simulation (ES) training techniques provide realistic tactical training under conditions that simulate the complex modern battlefield. Emphasis is on the psychological fidelity of the training environment and procedures (Root, 1976). Fidelity factors include the cues to which soldiers must respond, their opportunities to respond, and changes in the situation as a result of their actions. Three characteristics of ES exercises contribute to psychological fidelity: (a) they are two-sided, free-play tactical exercises; (b) they use objective, real-time casualty assessment; and (c) they simulate all weapons effects and signatures.

The earliest type of ES, Squad Combat Operations Exercise, Simulated (SCOPES), was developed for infantry squads. In SCOPES exercises, squads conduct two-sided, free-play exercises, so that each force opposes a motivated, intelligent enemy. Objective casualty assessment is achieved when a soldier, looking through a 6-power telescope mounted on his M16 rifle, correctly reads a 3-inch, two-digit number on the helmet of an opposing unit member. The telescope power and helmet number size are calibrated to produce hit/kill probabilities realistic for the weapon's lethality. When the soldier fires a blank round and correctly identifies the opposing helmet number, a casualty is assessed. If no blank is fired, a misfire is scored, and no casualty is assessed. A controller with the fire team radios the helmet number to the controller with the opposing team, who informs the "hit" target soldier. "Hit" soldiers must remove their helmets, lie down, and not communicate with those not "hit" or otherwise participate in the exercise.

The physical fidelity of this casualty-assessment method cannot be considered high. The soldiers do not know that they are casualties until a controller tells them they have been hit. However, because casualty assessment follows strict rules, "hit" soldiers realize they have performed incorrectly (e.g., did not stay under cover). Therefore, the situation has psychological fidelity. Soldiers learn very quickly to "low crawl."

The REALTRAIN method provides tactical ES training for combined arms elements. Objective casualty-assessment procedures have been established for M60 machinegun, hand grenade, M18A1 Claymore, M16A1 antipersonnel and M21 antitank mines, tank main gun, and light (LAW), medium (DRAGON), and heavy (TOW) antitank weapons. For weapons with longer ranges than that of the M16 rifle, the controller is equipped with optics to sight individual helmet numbers or numbers on panels attached

to vehicles. For example, tank controllers have 10-power breech-mounted telescopes and controllers with TOW gunners have 10-power telescopes mounted on the TOW sight.

Indirect fire, either mortar or artillery, is simulated by the detonation of artillery simulators at the impact locations requested by the players. The artillery simulators are delivered by fire markers, usually mounted in jeeps. When the simulators are detonated, controllers with the target players assess casualties within the "kill radius" of the simulated rounds. For example, exposed soldiers within a 50-meter radius of a simulated 4.2 inch (107 mm) mortar burst are assessed as casualties, and vehicles lose communications, although they are not destroyed. The communication loss enhances psychological fidelity by simulating confusion caused by indirect fire.

Pyrotechnics represent the sights and sounds of battle. Each soldier's weapon, crew-served weapon, and armored vehicle is equipped with pyrotechnics to simulate the flash and noise of the weapon signature. These signature simulators do not reproduce the exact actual weapon signatures but do intensify psychological fidelity by producing situation changes that necessitate realistic player responses. The firer may have an excellent position, but when he fires, the signature changes the situation by cuing the enemy to the firer's location. Firers are likely to be "hit" unless they move after firing.

ES training includes (a) a free-play tactical exercise, (b) an After Action Review (AAR), and (c) successive repetitions of the exercises and AAR. The exercise provides performance training under realistic tactical conditions in a discovery, or trial and error, paradigm coupled with structured feedback. Each exercise is followed by an AAR which recreates the action and provides the soldiers with additional information as to the consequences of their actions. Soldiers who "killed" other soldiers or "hit" vehicles describe how they detected and "destroyed" the enemy. "Casualties" hear from their peers what errors led to their being "hit." Although disagreements arise--sometimes very spirited, as motivation and competition are high--the objective casualty assessment system indicates "killers" and "killed" convincingly. The AAR leader guides the discussion but does not deliver a critique or lecture.

The AAR leader, usually a senior controller, is not assigned to a participating vehicle but coordinates the controllers, controls the exercise as a whole, and acts as the unit commander. The AAR leader uses a record of casualties to guide the discussion, which recaps the exercise chronologically. Personnel in an exercise control station keep the record, writing down the time and elements "hit" as the controllers report them on the radio. For example, for an individual soldier, the controller with the fire team reports "29 killed by 45, 29 killed by 45." The controller with individual 29 acknowledges the "hit" by reporting "29 confirmed, 29 confirmed." The exercise Net Control Station

(NCS) recorder writes the time, target number, and firer number, and checks that the "hit" was confirmed.

Between the exercise and the AAR, the AAR leader and the controllers meet to review, correct, and augment the NCS record to enhance the AAR. This controller debrief settles controversies over "hits" and derives training points to emphasize in the AAR.

Validations of both the infantry squad SCOPES and combined arms REALTRAIN indicate that tactical ES-trained units improve in such aspects of tactical proficiency as (a) maximizing effects of available weapons on the enemy, (b) minimizing effects of enemy weapons, (c) effectively coordinating within and among units, and (d) adaptively responding to enemy actions in a dynamic combat situation.

The SCOPES validation, conducted in May 1977, at Ford Ord, Cal., compared SCOPES-trained squads with conventionally trained squads (Banks et al., 1977). The REALTRAIN exercises, performed in Europe in 1975-1976, compared combined arms units with 3 weeks of ES training with similar units in their first week of ES training (Root et al., 1976). In addition to the positive performance indicators, controllers and participants reported that, in their opinions, the ES exercise provided effective training (more effective than conventional training).

The next step was to extend ES by developing a training program for armored cavalry units.

Armored Cavalry Engagement Simulation

The nature of armored cavalry presented a threefold challenge for ES development: the reconnaissance function, a combined arms composition, and the inclusion of mortar.

First, the armored cavalry, the "eyes and ears" of the maneuver forces, performs reconnaissance missions, gathering and reporting information. These missions do not lead to the casualty-producing engagements typical of other maneuver arms tactical training. Some missions are one-sided, with no firing--for example, reconnaissance of an area that does not contain enemy elements. Thus, all three aspects of ES that enhance psychological fidelity--casualty assessment, weapons effects, and signature simulators--would be inoperative. In other reconnaissance missions, enemy elements may be present, so that the exercise is two-sided. If the opposing elements fire on each other, the exercise converts to casualty-producing ES training, and standard ES procedures apply. If neither side fires, but both continue to gather and report information about enemy detection, the reconnaissance activities can be reenacted in the AAR. However, without special techniques, the AAR dialogue could incorporate only the opinions of one opposing force against the other, with no objective assessment such as the technique that makes ES casualty reports credible and convincing.

Second, the armored cavalry platoon, the smallest combined arms force in the Army, contains scout, light armor, infantry, and mortar sections. Field exercises involving all these elements must necessarily have a very broad scope, and free-play exercises can become very complex. As a result, the ES training system for armored cavalry had to be as comprehensive, yet as simple, as possible.

Third, because the mortar section is an integral part of the armored cavalry platoon, it was included in the tactical exercises. In past ES exercises, indirect fire elements were merely simulated, and fire markers delivered artillery-burst simulators to indirect-fire impact locations. In contrast, the mortar section was physically present with the maneuver forces in the ES armored cavalry exercises.

In addition to the aspects unique to armored cavalry, the usual aspects of engagement simulation were adapted as described below.

Weapon Effects and Signature Simulation. New hardware and accompanying procedures for its use were developed for some weapons, including (1) the M551 Sheridan--Armored Reconnaissance Airborne Assault Vehicle (with conventional high explosive antitank and Shillelagh missile); (2) M114 scout vehicle, Armored Command and Reconnaissance Carrier (with 20mm cannon); and (3) the 4.2 inch (107mm) mortar on the M106 Armored Mortar Carrier. Signature simulators and controller optics were devised and rules for their use established.

Exercise Control. Controller duties and communications, engagement rules, and casualty assessment were tailored to the vehicle type, crew, and weapon system. Each vehicle had one controller. The infantry had two controllers, one for each fire team. A senior controller with each opposing force functioned as the unit commander. The senior controller acted as the troop commander when armored cavalry platoons were the opposing forces.

Exercise Recording. In typical REALTRAIN exercises, NCS personnel record the simulated casualties and confirmations. To incorporate reconnaissance information, sightings (any detection of enemy activity and elements) were also reported, confirmed, and recorded on the NCS record. Reconnaissance information was also recorded in field notes kept by the vehicle controllers and logs of the tactical radio nets.

The REALTRAIN NCS records, tactical notes, and reconnaissance information were amalgamated during the controller debrief after the exercise and used as input to the AAR. Information-gathering and -reporting were emphasized more than in AAR's for typical REALTRAIN exercises.

Objectives

The overall objective was to develop engagement simulation for armored cavalry. The specific objectives in testing the candidate procedures were to examine the following:

1. Procedures designed to emphasize the reconnaissance functions in ES exercises,

2. Procedures for incorporating reconnaissance functions into the controller debrief and the After Action Review,

3. Controller procedures and the control system, and

4. Effectiveness of the weapons effects and signature simulators for armored cavalry weapons.

METHOD

Data Collection

Two types of instruments were developed to collect data. Forms and note cards recorded the information gathered and aided reporting. Questionnaires collected attitudinal data concerning the procedures, simulators, training value, and AAR.

Records of Information Gathering and Reporting Functions. Several procedures were tested to incorporate reconnaissance functions into the exercises. Some record sheets, primarily used for recording ES training exercise events, were adapted for use in collecting reconnaissance function data. The casualty record sheet typically maintained by the NCS during the exercises includes the target, firer, time, and confirmation of each casualty. This casualty record sheet was altered (Figure 1) to include reports of enemy detections (e.g., by sighting the enemy) in addition to casualties. The detection was called over the exercise control net in the same way as a casualty. The target (or sighted enemy element), firer (or element that sighted the enemy), time, and confirmation were recorded on the NCS sheet.

During the exercises the senior controllers kept notes, primarily on critical incidents and reconnaissance information from the troop tactical nets. The senior controller who conducted the AAR used these notes to reconstruct the action and to focus discussions of the reconnaissance functions.

Printed 3 x 5 cards prepared for the vehicle and infantry fire team controllers (Figure 2) were designed to encourage controllers to keep records of helmet and vehicle numbers, particularly those they controlled, and of the casualties. The controllers were instructed to

CONTROLLER CASUALTY/SIGHTING RECORD SHEET

Day _____ Period _____ Exercise No. _____

Senior Controller: Green Force _____ Brown Force _____

Senior Controller _____ (Name) Ops NCO _____ (Name)

	GREEN FORCE				BROWN FORCE			
Vehicle Nos.	Helmet Numbers				Vehicle Nos.	Helmet Numbers		

EVENT SEQUENCE RECORD

Target or Observed Element	Firer / Observer	Time of Fire, Sight	Confirm	Comments, Notes

Figure 1. Revised Net Control Station record.

Front of 3 x 5 Card

Day _____ Period _____ Ex. No. _____

Vehicle No. _____ Green _____ Brown _____

Rank/Name _____

GREEN Vehicle Numbers:	BROWN Vehicle Numbers:
___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___	___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___
Helmet Numbers:	**Helmet Numbers:**
___ ___	___ ___

Back of 3 x 5 Card

Frag. Order:

Troop Questions:

Material Equipment Problems:

Locations (Sightings & Where Seen):

Figure 2. Controller field note card.

write numbers of the individuals and vehicles they controlled on one side of the card at the start of the exercise. On the reverse side of the card, controllers were instructed to keep notes of orders, plans, troop questions, problems, and enemy detections to enrich their later participation in the controller debrief.

Research personnel recorded data in exercise sketches and narratives to determine the utility of these records in an implemented training system. Three copies of a sketch of the major terrain features of each exercise lane were drawn from a 1:50,000 scale map of the area. These blank sketch maps were used to pinpoint initial vehicle locations, casualty locations, and final positions of survivors, and to show movement.

Narrative descriptions of the exercises augmented the sketches. A form outlining the major components of the plan of execution by the platoon leader simplified narrative information recording.

Indirect Measures. Questionnaires recorded subjective judgments of the participants and controllers. Participants were asked to rate training value, simulator credibility, and utility of the candidate procedures. Vehicle and infantry fire team controllers were asked about casualty assessment and other ES procedures, hardware utility, simulator credibility, controller debrief and AAR, and training value of the exercises for the controllers.

Preliminary Field Tests

Procedures drafted for armored cavalry ES were examined and revised in a series of field tests developmental in nature, rather than validations of a completed system. Although data were collected whenever possible, no formal experiments were conducted. Field validation, as conducted for SCOPES and REALTRAIN, awaits completion of an initial system for armored cavalry ES.

Table 1 summarizes the field tests for armored cavalry ES. Some small-scale exploratory tests examined the draft procedures and the hardware devised to simulate the armored cavalry weapons. The exploratory tests were done during Basic Noncommissioned Officer Courses (BNCOC) at Fort Hood and Fort Bliss. BNCOC prepares soldiers for squad leader (E6) positions in infantry, armor, artillery, combat engineer, and air defense. The course includes 3 days of ES exercises.

Fort Hood BNCOC Exercises. The Fort Hood BNCOC ES exercises included infantry squads and tanks, with approximately 10 vehicles per exercise. The instructors added a scout squad to one of the opposing forces and used it with no difficulty. The machineguns mounted on the scout vehicles had been simulated previously in ES exercises, and the procedures were satisfactory for the scouts. These exercises were an

Table 1

Armored Cavalry Developmental Field Tests

Host unit and location	Test period	Vehicles tested	Other objectives
Basic NCO courses, Fort Hood	Jan. - Feb. 1977	Scout vehicle M151, M60 MG	Pretest reconnaissance procedures
Basic NCO courses, Fort Bliss	April 1977	Sheridan, M551	Refine data instruments Pretest new reconnaissance procedures After-Action Review emphasis on reconnaissance
3rd Armored Cavalry Regiment, Fort Bliss	May 1977	Scout vehicles M114, 20mm cannon M113, TOW Sheridan, M551 Mortar, 4.2 in (107mm)	Reconnaissance data Reconnaissance After-Action Review Exercise recording Exercise control

important first step in the armored cavalry engagement-simulation development. Although no formal data were collected, the inclusion of scouts was obviously feasible. The BNCOC instructors provided valuable ideas for further development of armored cavalry ES and tried out data collection forms before the forms were used in larger exercises.

Fort Bliss BNCOC Exercises. The Fort Bliss BNCOC tests focused on integration of the reconnaissance functions and initial use of procedures for the Sheridan weapons effects and signature simulators. Three exercises employed scouts, light armor, and infantry squads, with approximately eight vehicles per exercise. BNCOC students served as controllers, and some of the instructors helped manage the exercises. The instructors' highly skilled assistance in small, easily manageable exercises facilitated the examination of new procedures.

The scouts were mounted in armored personnel carriers with .50 caliber machineguns and in the same type of vehicles that had been tested at Fort Hood. Since these vehicles and weapons both had been tested before in ES exercises, it simply was verified that their simulation was satisfactory. The primary vehicle to be examined during the Fort Bliss BNCOC exercises was the Sheridan.

The signature simulator intended for the Sheridan main gun is the Hoffman device, which has simulated the M60 tank main gun successfully in previous ES exercises. Unfortunately, Hoffman rounds were not available for these tests. The substitute, an M116 hand grenade simulator, was detonated to simulate the noise and flash of the gun. The Hoffman device, which provides more realistic noise and flash, is preferred.

A modified missile aft cap, with a 10-power telescope inserted in the center, was used in the breech of the main gun as the controller telescope. It seemed satisfactory during the BNCOC exercises.

Some methods for incorporating the reconnaissance functions were pretested at the Fort Bliss BNCOC. Enemy detection information was reported over the exercise control net. Of 25 sightings reported, only 4 were confirmed. These reports contributed little to the AAR. Reporting them over the exercise control net substantially increased the load on the net, depending on the number of reports attempted.

Vehicle and infantry fire team controllers were provided with 3 x 5 cards to record the ES numbers and notes for the controller debrief. Almost all the BNCOC controllers used the cards, 19 of the 20 possible instances. Eighteen cards were used for notes for the controller debrief, and 11 were used to record ES numbers (some cards were used for both functions).

The senior controllers kept their own notes during the exercise or had note-taking assistants in their jeeps. The senior controllers used these notes during the AAR to reconstruct the action, incorporating the notes with the maneuver exercise records of sightings reported over the control net. However, even with all these sources of data, or perhaps because of them, it was very difficult to incorporate the reconnaissance information into the AAR. Information was too scattered and too complex to bring together quickly after the field exercise.

The BNCOC participants and controllers completed questionnaires (described in the Subjective Evaluations of Training section) and also commented on them. Their responses and comments were used to revise the questionnaires before use in larger exercises.

Platoon Exercises

Armored cavalry ES procedures were revised on the basis of the BNCOC results, and tested in May 1977, with troop support provided by the 3rd Armored Cavalry Regiment (ACR), Fort Bliss, Tex. C Troop, 1st Squadron, was the test unit.

Controller Training. The first 3 days of the 2-week test were devoted to controller training, in which C Troop personnel were trained in ES procedures, controller duties, and the After Action Review. Controllers and participants practiced their duties in approximately 8 hours of practical exercises. In these practical exercises, the platoon was divided into sections, so that the opposing forces were scouts versus scouts, infantry versus infantry, and Sheridans versus Sheridans.

A communication exercise familiarized the controllers with ES procedures and duties. The full complement of controllers practiced sending, receiving, and confirming typical ES control messages over a radio net prior to the first full-sized exercise. The transmissions were tape-recorded and played back for discussion. Two sessions, with playback, were conducted. This communications training was evaluated so favorably that it was incorporated forthwith into the REALTRAIN implementation program.

Exercises. Six days of platoon versus platoon exercises were conducted, with one exercise and After Action Review each day. The armored cavalry platoon composition, with vehicles integral to the test unit, is shown in Figure 3. Due to staffing levels and maintenance requirements, fewer than the full complement of 10 vehicles per platoon participated in some exercises. Each platoon in C Troop participated as one of the opposing forces in four exercises (Table 2), and as controllers in the other two exercises.

HEADQUARTERS SECTION

PLATOON LEADER
M114
(20MM CANNON)

SCOUT SECTION

SCOUT SQUAD
M114
(20MM CANNON)

M113
(TOW)

SCOUT SQUAD
M114
(20MM CANNON)

M113
(TOW)

LIGHT ARMOR SECTION
3 - SHERIDANS, M551
(152MM CONVENTIONAL ROUND AND MISSILE)

RIFLE SQUAD
M113
(.50 CAL. MACHINE GUN)

MORTAR SQUAD
M106
(4.2 INCH (107MM) MORTAR)

Figure 3. Armored cavalry platoon composition during ES exercises.

Table 2

Platoon Missions by Exercise

Exercise	Platoon	Mission	Platoon	Mission
1	1	Route reconnaissance	3	Screen
2	1	Delay	3	Zone reconnaissance
3	3	Route reconnaissance	2	Screen
4	3	Delay	2	Route reconnaissance
5	2	Zone reconnaissance	1	Delay
6	2	Route reconnaissance	1	Screen

Missions. Missions were selected from the "Army Training and Evaluation Program for Armored Cavalry Squadron and Armored Cavalry Troop" (ARTEP 17-55), with assistance of 1st Squadron personnel. The missions were appropriate for a regimental squadron, considered to be of training benefit to C Troop, and emphasized reconnaissance functions. They represent Level 1 ARTEP missions, comprising the minimum acceptable performance for a combat-ready, full-strength unit. Missions were paired in each exercise so that one platoon had a reconnaissance mission while the opposing platoon had a screen or delay mission (Table 2). The platoon with the screen or delay mission was given time to prepare a position before the opposing platoon moved. The 1:1 force ratio was tactically unrealistic for what amounted to an attack against a prepared defense, but training each platoon as a unit was highly desirable.

Terrain. The flat desert training area had only 40 feet difference between the high and low elevation. It was dotted with sand dunes and low scrub vegetation. Unpaved trails, the only features useful in position location, were visible for only short distances because of the sand dunes. The exercise lanes were approximately 3 by 6 kilometers. The major axis of each exercise lane followed one of the trails. Position location proved to be very difficult and unreliable on this terrain. Figure 4 shows how the sand dunes hid the numbers.

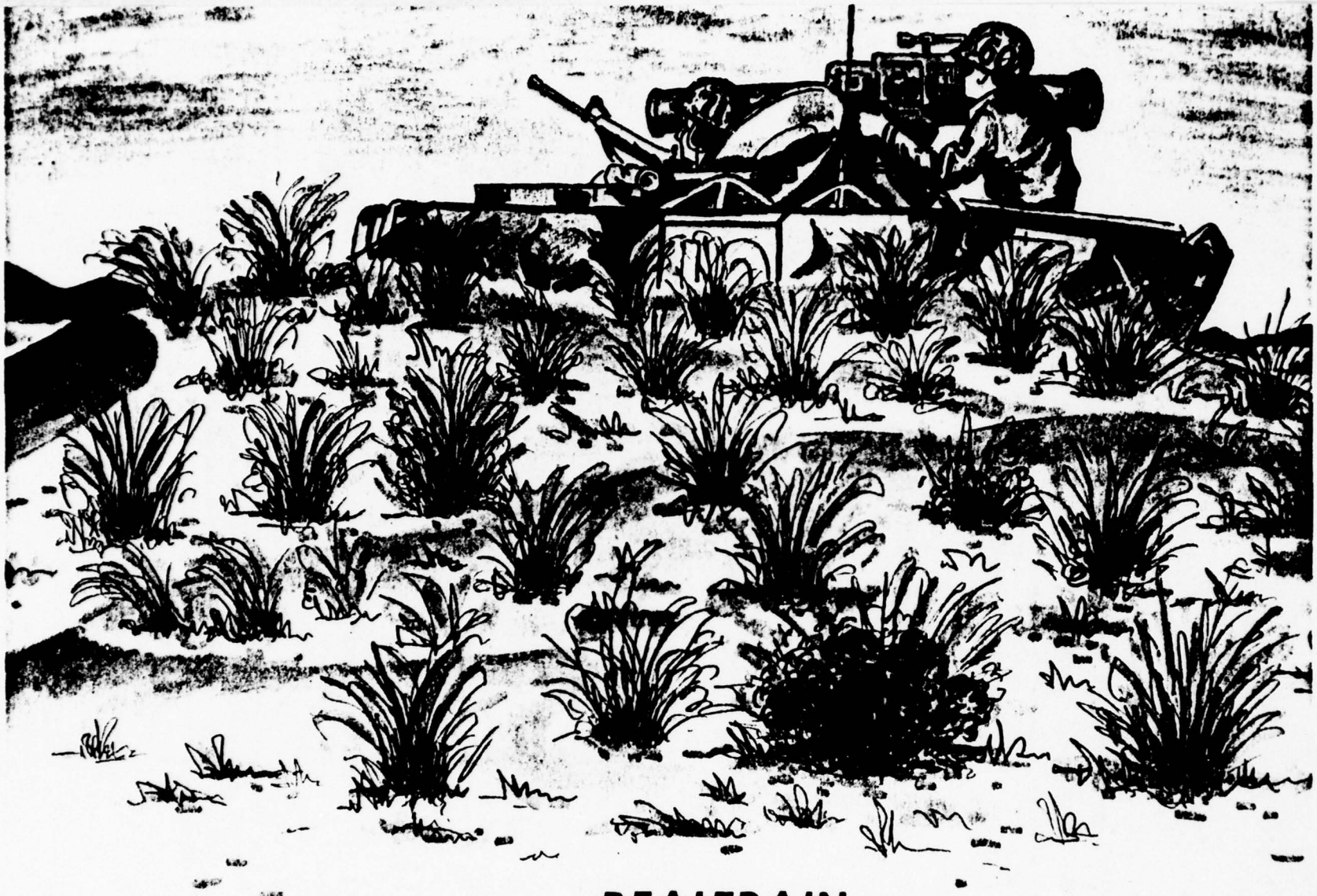

Figure 4. Target confirmation difficulties caused by terrain.

Lack of distinguishable terrain features, and inexperience of the controller, made the location determinations difficult and inaccurate. The senior controllers had to locate the vehicles, often by extensive use of the radio, substantially increasing the load on the exercise control radio net over the load in typical exercises. These additional transmissions taxed the senior controllers, who were responsible for troop command as well as exercise control. Heavy transmission load on the control net degrades the exercises by interfering with controller reports and confirmations of casualties.

Slow or inaccurate removal of elements reported as targets decreases the realism during the exercise and makes reconstruction of the action in the AAR less convincing. For example, since accurate coordinates were difficult to determine, the crews of target vehicles were not convinced that their vehicles were the ones reported as "hit," especially if other vehicles were nearby. Thus, reinforcement value from the objective, definite casualty system decreased in approximately half of the simulated engagements during these exercises.

Results of Incorporating Reconnaissance Functions

Enemy detection information was reported over the exercise control net in the first two platoon exercises. Only four sightings were reported, and only one was confirmed. These reports contributed little to the AAR, but they increased the load on the control net. Due to the low utility and interference with the control net, sighting reports were discontinued after the second platoon exercise.

The senior controllers found that the notes they kept during the exercises were the most helpful tactical record during the controller debrief and the AAR. Such notes are difficult for the senior controllers to maintain, since they are traveling over rough terrain, and since they have the additional responsibility of functioning as unit commanders. Improvement of note-taking methods and use of the senior controller notes will be emphasized in the future.

Vehicle and infantry fire team controllers in the platoon exercises were given 3 x 5 cards to record ES numbers and notes for the controller debrief. The controllers used almost all the cards (111 of 120, or 93%). Over half the cards were used to record the ES numbers (81 of 120, or 68%), just less than half to record notes for the controller debrief (50 of 120, or 42%). (Some of cards were used for both numbers and notes.) This field note card usage rate is high, compared to typical paperwork usage in field exercises.

RESULTS

Target Reports and Confirmations

The objective casualty system described in the introduction is a primary strength of ES training. Confirmed casualty information, with certainty as to who engaged whom, provides immediate and definite feedback. In contrast to typical ES exercises, where virtually all casualties are reported by number and confirmed, only a third (31 of 104 targets) of the casualties were reported by number and confirmed in this test (Table 3). Of the 104 targets reported during the six exercises, 38% were reported by ES number, while 62% were reported by coordinates.

Table 3

Target Reports and Confirmations

Confirmation	Targets reported		
	By ES Number	By Coordinates	Total
Yes	31	29	60
No	9	35	44
Total	40	64	104

Terrain characteristics appeared responsible for the low number of target reports by number. The opposing forces were unable to maneuver without being detected at long ranges by their vehicles' exhaust smoke or by dust clouds. Thus, either vehicles were engaged at ranges beyond those in which target numbers were legible, or sand dunes obscured the number panels. In listing problems in identifying the ES numbers of opposing vehicles, controllers cited the engagement distances as the main difficulty. Of the 48 controllers who responded to the question, 29 (60%) reported that the enemy vehicles were too far away for their numbers to be read.

Only 58% of the targets were confirmed (60 of the 104 targets reported). The percent of confirmations was significantly higher for targets reported by ES number (78%) rather than by coordinates (45%: $z = 3.18$, $p < .01$). Targets reported by ES number are easier to confirm, since the controller on the target vehicle can hear and respond to the radio message. Confirmation of a target reported by coordinates requires that the senior controllers carefully check vehicle positions and contact possible target vehicles individually in an attempt to confirm the report.

The high usage rate is corroborated by the controllers' ratings of field note card utility (for both ES numbers and notes):

Good	58%
Fair	33%
Poor	8%

Overall, the controllers (N = 48) reported favorably on the helpfulness of the field notes:

Very helpful	44%
Somewhat helpful	19%
Not helpful	6%
Didn't take notes	25%
No response	6%

During the six platoon exercises, 91 tactical reports were recorded from the troop tactical radio net. Approximately half (45) were reports of enemy sightings, an average of 7.5 reports per exercise. Although the number of sightings is not high, sorting through the reports to find the relevant ones was not accomplished before or during the controller debrief. Procedures are being drafted for the next field experiment to enable the AAR leader to use the tactical radio net records to reconstruct the action, especially for the reconnaissance functions.

Exercise Sketch and Narrative

A copy of the terrain sketch map was given to the researcher riding with each platoon leader. The researcher was responsible for plotting the initial locations of all vehicles in his platoon, locations where vehicles were destroyed, and final positions of survivors. At the end of the exercise, the two platoon sketches were verified with the platoon leaders and platoon sergeants, and the information from the two partial sketches was consolidated on the third terrain sketch copy. With additional data from the net control sheet, vehicle casualties were recorded on the sketch, with times of occurrence and identification of firer. The end result depicted routes of movement of vehicles from start to finish, with approximate locations of initial positions, casualty locations, and final positions for both teams.

Preparation of the exercise narrative began when research personnel recorded the operations orders issued by platoon leaders to obtain information about their plans of execution of the mission. During the course of the exercise, the researcher with each team could then record observations of the actual execution of the plan, and note deviations from the plan.

Sufficient time elapsed between the termination of an exercise and the beginning of the controller debrief to verify vehicle positions and to consolidate this information onto a single sketch. Information from the controller debrief and AAR were integrated with the draft exercise narratives. Thus, the narratives were not available until after the conclusion of the entire training process for a given exercise. Neither the sketch nor the narrative was applied to improve training during the test; however, the potential of both techniques, for training diagnosis on a longer range basis, was noted.

The exercise sketch procedures can be applied immediately. In the second developmental test, the emphasis on reconnaissance functions will require more detailed records of tactical activities to augment the net control sheet. Unit personnel, in contrast to research personnel, will make the exercise sketches and the AAR leader will use the sketches to conduct the AAR, without normally used casualty information.

A sample exercise sketch is shown in Appendix A and an exercise narrative in Appendix B.

Casualty Assessment Procedure

Casualty-assessment rules, printed on cards, were distributed to the controllers. These cards, used in conjunction with the casualty assessment training, appeared to be effective. Most controllers had no problems with casualty assessment (39 of the 48 controllers who answered the question, or 81%, marked the response category "no problems"). Their reports were consistent with observations by the military training advisors and research personnel.

Vehicle Casualty Results, by Mission

Table 4 presents vehicle casualties by mission type. Platoons assigned reconnaissance missions (zone or route) lost 65% of their vehicles, while platoons with screen or delay missions lost only 34%. These outcomes appear realistic, given the 1:1 force ratios of the moving and defending elements. When equal forces meet in battle, the moving force is expected to be at a disadvantage, compared to the force in a prepared position. The realistic outcome statistics attested to the realism of the exercise itself.

Table 4

Vehicle Casualties by Mission Type

Mission	No. vehicles played	No. vehicles "hit"	% vehicles "hit"
Route reconnaissance	36	22	61%
Zone reconnaissance	18	13	72%
Reconnaissance total	54	35	65%
Screen	26	11	42%
Delay	27	7	26%
Prepared position total	53	18	34%
Totals	107	53	49.5%

Weapons Effects and Signature Simulators

Procedures and hardware for simulating the M114 scout vehicle 20mm cannon, M551 Sheridan main gun, and 4.2 inch (107mm) mortar were evaluated. The M113 armored personnel carrier with either the .50 caliber machinegun or TOW was also played, but the evaluation of its weapons was not a primary issue because they have been used in past ES exercises.

Table 5 shows that the TOW missile inflicted the largest number of vehicle casualties, accounting for 23 of the total 53 vehicles "destroyed." The TOW missile has long range and high lethality, and so it accounts for a large portion of the casualties. The TOW scout vehicle, a leading element of the platoon, contacts the opposing force early in the exercise. In this test, both the TOW missile and .50 caliber machinegun mounted on the same vehicle were used effectively.

M114 Scout Vehicle With 20mm Gun/Cannon. The 20mm cannon signature was simulated by an M117 flash simulator. Several simulators were attached to a board on the M114 scout vehicle front and were detonated by pulling a trip wire. The simulator was easy to hear but did not represent the ideal gun signature. Safety was a major problem in accidental

Table 5

Vehicle Casualties by Weapon Type

Firer	Number and percent of targets													
	Platoon leader M114		Scout M114		Scout TOW M113		Sheridan M551		Mortar M106		Infantry M113		All Targets	
M114 20mm gun			1	7%	2	15%	2	14%					5	9%
TOW missile	2	33%[a]	7	50%	5	38%	7	50%			2	50%	23	43%
.50 cal machinegun on TOW M113	2	33%	1	7%	2	15%	1	7%					6	11%
Sheridan 152mm gun			2	14%			1	7%					3	6%
Mortar	2	33%	3	21%	2	15%	1	7%	2	100%	1	25%	11	21%
LAW					2	15%	2	14%			1	25%	5	9%
Total vehicle targets / Total vehicles played	6/12 = 50%[b]		14/21 = 67%		13/24 = 54%		14/29 = 48%		2/12 = 17%		4/9 = 44%		53/107 = 50%	

[a] 33% of the 6 Platoon leader vehicles "killed" were hit by TOW missiles.
[b] 50% of the 12 Platoon leader vehicles that played were "killed."

firings. The M117 is an interim device to be used only until a signature simulator is developed for the 20mm cannon.

Controller optics for the 20mm cannon were fabricated from the TOW controller optics. A 10-power telescope was attached to the cannon above the gunner's 13-power sight. During the 2 weeks of the exercises, threads in the mounting block became damaged so that the telescope worked loose and did not remain aligned with the gunner's sights. Thus, the controller's sight picture differed from the gunner's, and the controller could not identify targets properly. The mount is being improved to solve this problem.

M551 Sheridan With 152mm Gun/Missile Launcher. The same signature simulator (M116 hand grenade simulator) and controller optics were used as in the BNCOC tests. The controllers and participants reported that the hand grenade simulator was easy to hear and realistically simulated the main gun, but they also suggested that the signature simulation be improved as to loudness, flash, and smoke. When used in this armored cavalry application, the Hoffman device will provide these improvements and the necessary realism.

The modified missile aft cap, with a 10-power telescope inserted in the center, proved unsatisfactory during the platoon exercises. During the exercises, the aft cap vibrated loose and, on occasions, fell out of the breech. The missile aft cap has been further modified to correct this problem.

Sheridans contributed relatively little to the vehicle casualties (Table 5), despite the long range and high lethality of their main gun. They were held in reserve to react to enemy contact instead of joining the casualty-producing engagements. The TOW section was well forward, and the tendency was to engage with the TOW because of its availability and to disregard its reconnaissance function.

M106 Armored Mortar Carrier With 4.2 Inch (107mm) Mortar. Two procedures were tested for incorporating the mortar section into ES exercises. For both procedures, the mortar section was physically present as part of the platoon. One procedure establishes a miniaturized firing range, 50 meters of level ground measured with a rope scale, at the location selected for the mortar as part of the tactical play. A pneumatic training device attached to the mortar shoots a plastic dart when fired by the mortar crew. The plastic dart travels only a fraction of the distance of a real round. Using the reduced scale range, controllers are able to transfer coordinates to the exercise lane and determine quickly where to deliver the artillery simulators.

The mortar crew trains with the platoon, practices mortar procedures, and has the effects of its actions transferred to the maneuver exercise. The plastic darts are safer and less expensive than live ammunition. The procedure appeared to be feasible, but it could not be used during these exercises, because the sand dunes in the Fort Bliss terrain interfered with placement of the rope scale.

In the alternate mortar procedure that was used, a mortar controller observed the fire direction and gunnery procedures. When he detected errors, he computed an impact point and notified the fire marker to deliver the simulated rounds to the corrected location rather than to the location requested by the observer. These procedures proved too complex for one controller (observe two sets of crew members, compute impact points, operate the radio, and record the procedures). Future tests will examine the assignment of two controllers and simplified procedures.

The mortars, which remained in the rear of the armored cavalry platoons, were the vehicles least often engaged (Table 5). However, two mortars were hit by indirect fire from the opposing force. One mortar crew had selected as its initial location a major terrain feature (trail junction) that was also chosen as an opposing force preplanned target. The training value regarding position selection was evident after the hit. The crews discussed this issue and quickly learned to select less obvious positions.

Fire Marker Transportation. Fire markers, who deliver the artillery-burst simulators to the requested impact locations, usually travel in jeeps. In this test, an OH-58 helicopter was tried as the fire marker vehicle. Only one helicopter was employed (for safety over the small exercise lane); therefore, only one force could have indirect fire simulation at any one time. The helicopter had to leave the training area to refuel before the exercises ended, terminating indirect fire support. The helicopter was on station approximately 90% of the exercise time.

The indirect fire simulation system produced 11 simulated vehicle engagements, 21% of the total hits. Since mortar hits knock out communications and "kill" exposed personnel but do not destroy vehicles, the 11 simulated vehicle engagements did not destroy the vehicles. In one case, a vehicle "hit" by simulated mortar fire early in the exercise later was "destroyed" by .50 caliber machinegun fire. Previous indirect fire simulation has shown a higher proportion of hits. For example, during the REALTRAIN validation in Europe indirect fire accounted for 31% to 32% of the personnel and vehicle casualties. Problems with the helicopter and terrain, and various characteristics of the indirect fire simulation and unit composition in the Fort Bliss exercises appeared to reduce the mortar effectiveness.

Subjective Evaluations of Training

Participants and controllers were asked for their subjective evaluations of the training value of the ES exercises and of how the ES exercises compared with other training.

Participants (N = 77) responded as follows to the question, "How much would you say you learned during the training exercises you have just completed?":

A great deal	44%
Some	38%
Little or nothing	18%

When asked to compare the ES exercises to other training, most participants preferred the ES exercises, as follows:

REALTRAIN much better	36%
REALTRAIN better	43%
No difference	11%
REALTRAIN worse	11%

Approximately the same percentage of Fort Bliss and European REALTRAIN answers fall in the combined "better" and "much better" categories, but in the European data, the majority responded that REALTRAIN ES training was "much more effective." Some response differences may be due to scaling and administrative differences. Some of the training value, or at least the perception of the training value, may have been lost because of the problems that arose in conducting these armored cavalry exercises. Whether participants would report more perceived training value if the exercises were better run (e.g., improved target reporting and confirmation) remains to be tested in future exercises. The armored cavalry exercises did entail development of a new system, in contrast to the European validation of smoothly conducted training.

Controllers (N = 48) were asked how much they learned about tactics when they served as controllers. Responses show that they perceive that they are learning, often as much as or more than if they are part of the tactical team, as follows:

I certainly learned as much, or more, as a controller, as I would have if I'd been part of the tactical team.	54%
I learned a fair amount about tactics while acting as a controller.	33%

I didn't learn very much about tactics when I was controlling.	13%

During the REALTRAIN validation in Europe, 70% of the controllers reported that training value was much greater for controllers than for participants. The Fort Bliss controllers were less positive concerning the training value of these exercises. These responses may reflect the exercise problems previously described.

CONCLUSIONS AND DISCUSSION

This phase of testing was not designed to produce final answers but rather to explore and refine specific ES procedures for use by armored cavalry elements. Data on training effectiveness were not sought at this point in the developmental sequence, but (a) perceptions of training value were collected from participants and controller personnel and (b) changes in tactical behavior over the series of exercises indicated that some learning had occurred. However, these measures do not represent the thorough training effectiveness evaluation that would be conducted in a validation study. Performance measures appropriate for training effectiveness analysis will be tried in the next field test, but an objective training effectiveness analysis must wait for the validation.

These initial tests revealed several modifications desirable for the controller optics, signature simulators, and mortar controller procedures. The controller duties pertaining to casualty assessment appeared to be satisfactory. Given the modifications indicated, the casualty-related aspects are ready to be written into the training program for armored cavalry ES.

All the exercises in these tests contained a large number of simulated engagements and in that respect were similar to typical ES exercises. However, when dealing with armored cavalry, a special emphasis must be placed on reconnaissance functions. While the procedures examined in the initial tests for incorporating reconnaissance activities were steps in the right direction, additional development is required to play the reconnaissance functions fully.

A reconnaissance-emphasizing approach containing several interrelated techniques is planned for the next field test. The exercise scenarios and operations orders will be designed to limit engagements and to foster reconnaissance behaviors. When the simulated engagements are limited, controllers can concentrate on observing and recording information-gathering and -reporting activities. The controller records, combined with records that appeared to be effective in the initial tests, are expected to increase objectivity about reconnaissance activities. Without such records, the subjective and often conflicting judgments of the opposing forces constitute the only basis for discussion. Increasing the objectivity, or records of "ground truth," is expected to enhance

credibility and, in turn, increase troop motivation and training value. Continued development of armored cavalry ES will focus on building the strengths of typical, casualty-producing ES into reconnaissance ES exercises. This plan revolves around realistic combat scenarios involving motivated opposing forces in an environment with strong psychological fidelity. Troops trained with ES may not have been in combat, but they have had the opportunity to learn the lessons of combat without having to learn the hard way.

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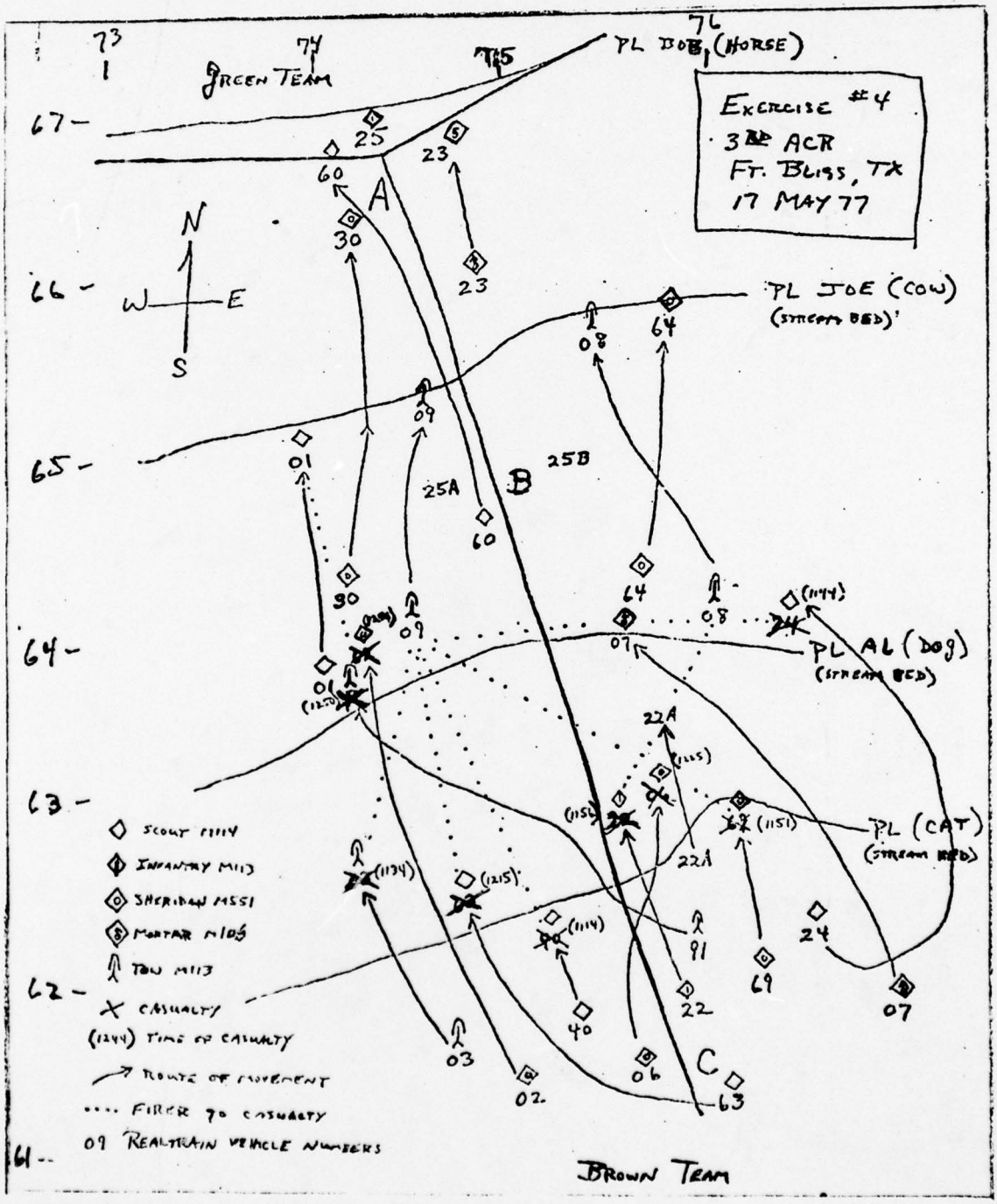
APPENDIX A

EXERCISE SKETCH



APPENDIX B

EXERCISE NARRATIVE

EXERCISE NARRATIVE - 3rd ACR Ex #4
Fort Bliss, Tex.
17 May 77

Weather. Clear, 85°F.

Terrain. The exercise lane was approximately 6 km long and 3 km wide. Terrain was open desert with sand dunes large enough to conceal armored vehicles in at least partial defilade positions. A low ridge line crossed the center of the lane between Phase Lines AL (Dog) and JOE (Cow). Vegetation was low desert brush, yucca plants, and such. A road ran along the main axis of the lane in a generally north-south direction. There were no other prominent terrain features.

The following checkpoints are indicated on the exercise sketch: ALPHA - Road junction at north end of lane, BRAVO - Initial position of Green Team, CHARLIE - Brown Team assembly area.

Green Team Plan. Green Team consisted of two M114s, two TOWs, two Sheridans, one mortar vehicle, and one infantry squad with M113. Green assembly area was near PL JOE, from whence it moved to its IDP between checkpoint BRAVO and PL AL. Its mission was to conduct a defense in sector.

Green planned to place scout teams on either side of the road and to support them with Sheridans. The mortar was to be initially in the assembly area, then to displace forward later. The infantry squad was broken down into two tank hunter-killer teams and was to be placed initially near checkpoint BRAVO, to go to work whenever platoon was ordered to move back to position near checkpoint ALPHA. The TOWs were to be dismounted from their vehicles on either flank and TOW crews were given orders to engage any enemy vehicles they observed.

Brown Team Plan. Brown Team consisted of three M114s, two TOWs, three Sheridans, one mortar vehicle, and one infantry squad with M113. Brown assembly area was near checkpoint CHARLIE. Its mission was a route reconnaissance along the north-south road from checkpoint CHARLIE to a point north of checkpoint ALPHA. The infantry squad was dismounted to perform the reconnaissance of the road itself.

Brown planned to move with one element (scout, TOW, and Sheridan) on one side of the road and another element (scout, TOW, and two Sheridans) on the other side of the road. The infantry stayed along the road, and the Platoon Leader vehicle was to stay to the rear near the road.

Outcome. Green Team had a clear victory. Brown lost all its vehicles except the mortar vehicle, although it had dismounted infantry and a number of individuals from other vehicles on the ground at the end of the exercise. Green lost no vehicles and only one individual.

Discussion. Green Team set up its defensive position as planned. While in the IDP, Green inflicted most of its casualties on Brown. Green was ordered to move back to a position near checkpoint ALPHA; however, it was not until an hour later that the pullback was completed, since Green Leader instructed his vehicles (scouts) to maintain contact with the enemy. One TOW vehicle (09) inflicted five vehicle casualties on Brown (although it was later determined that 09 had itself been destroyed by Brown after it inflicted its first casualty). Green Leader forwarded nine reports to higher headquarters during the course of the exercise. Frequent use of indirect fire was made.

Brown Team deployed according to plan. The element to the west of the road entered a large depression and began to suffer casualties. Since Green was positioned in a good defensive position on higher ground, it was difficult for Brown to maneuver. The result was that Brown lost all but its mortar vehicle and several dismounted troops to direct and indirect fire by Green while Brown was attempting to cross the lower terrain. Only three or four reports were forwarded by Brown Leader to higher headquarters. Indirect fire missions were called frequently (too frequently and too far-ranging, in fact, for a mortar to handle within the constraints of time and ground location involved in the fire missions as ordered by Brown Leader).